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**Kansteiner**

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(54) **PRE-WEAKENED COVER FOR AN AIRBAG AND METHOD OF MAKING**

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(51) **Int. Cl.**

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CPC ..... ***B60R 21/2165*** (2013.01); ***B26D 3/00*** (2013.01); ***B60R 21/205*** (2013.01); *B60R 2021/21652* (2013.01); *Y10T 83/02* (2015.04); *Y10T 83/0341* (2015.04)

(58) **Field of Classification Search**

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USPC ..... 280/728.3, 732; 219/121.68–121.71
See application file for complete search history.

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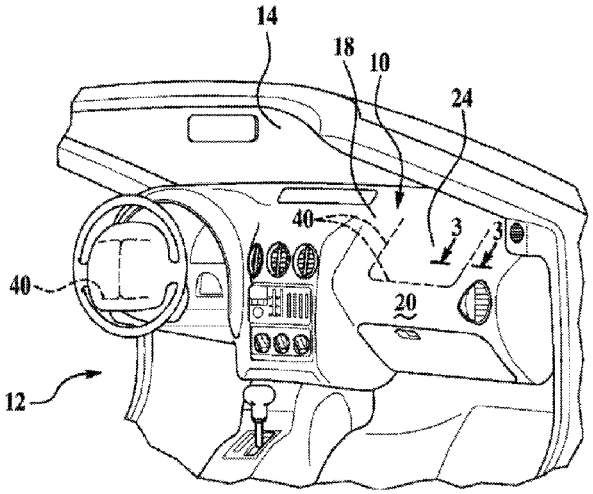
(57) **ABSTRACT**

A pre-weakened cover of an airbag module is provided including a layer having an outer show surface and an opposing inner surface. A plurality of first cuts is arranged at a first angle on the inner surface. A plurality of second cuts is arranged at a second angle on the inner surface. Each of the second cuts intersects two adjacent first cuts to form a generally V-shaped pattern.

**15 Claims, 6 Drawing Sheets**



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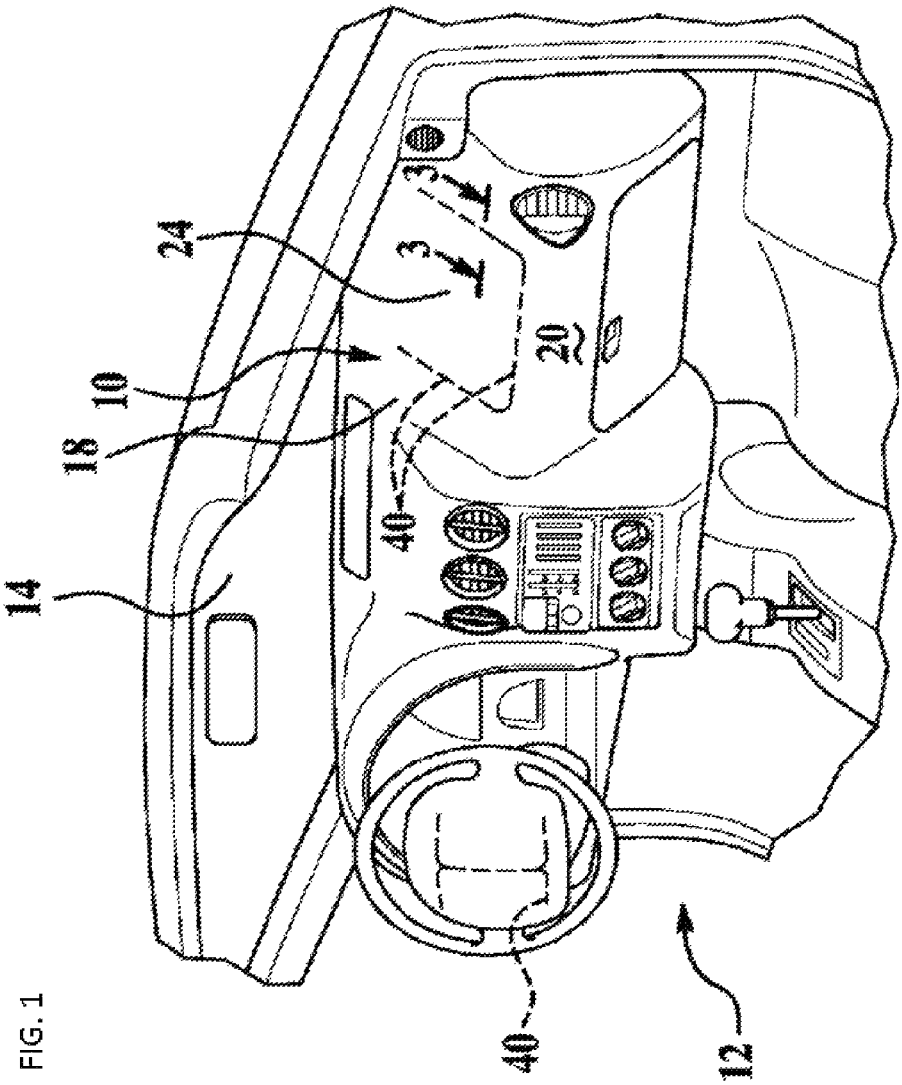


FIG. 1

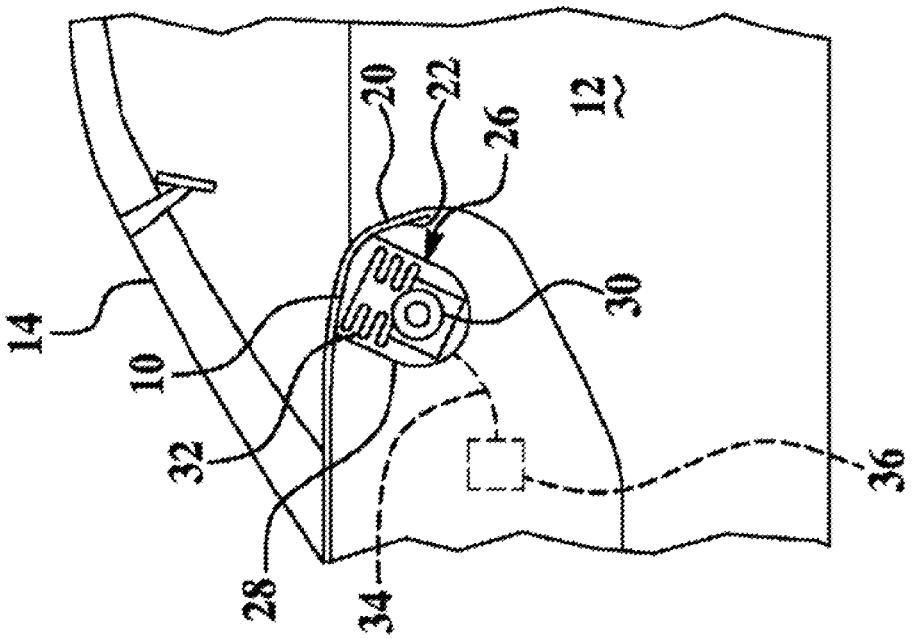


FIG. 2

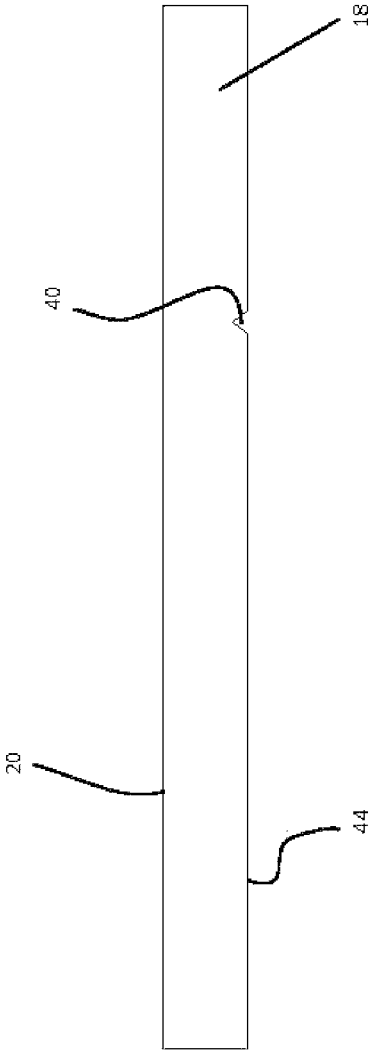


FIG. 3

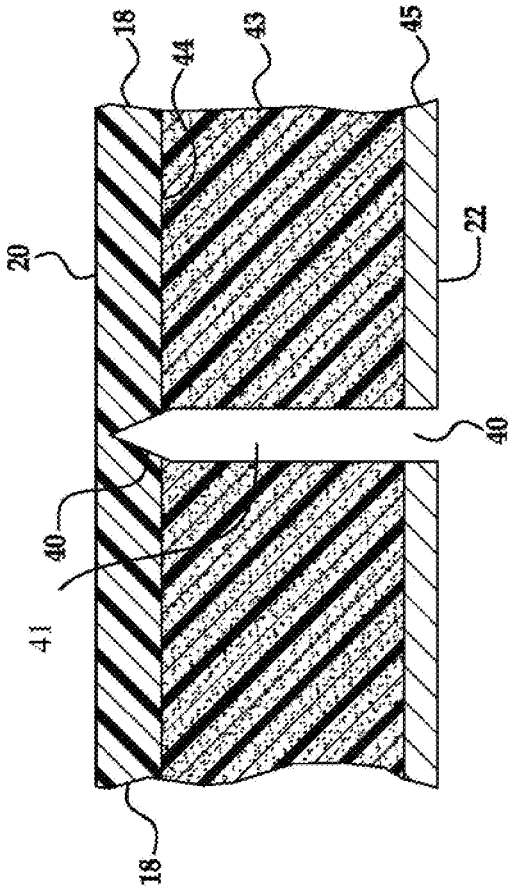


FIG. 3A

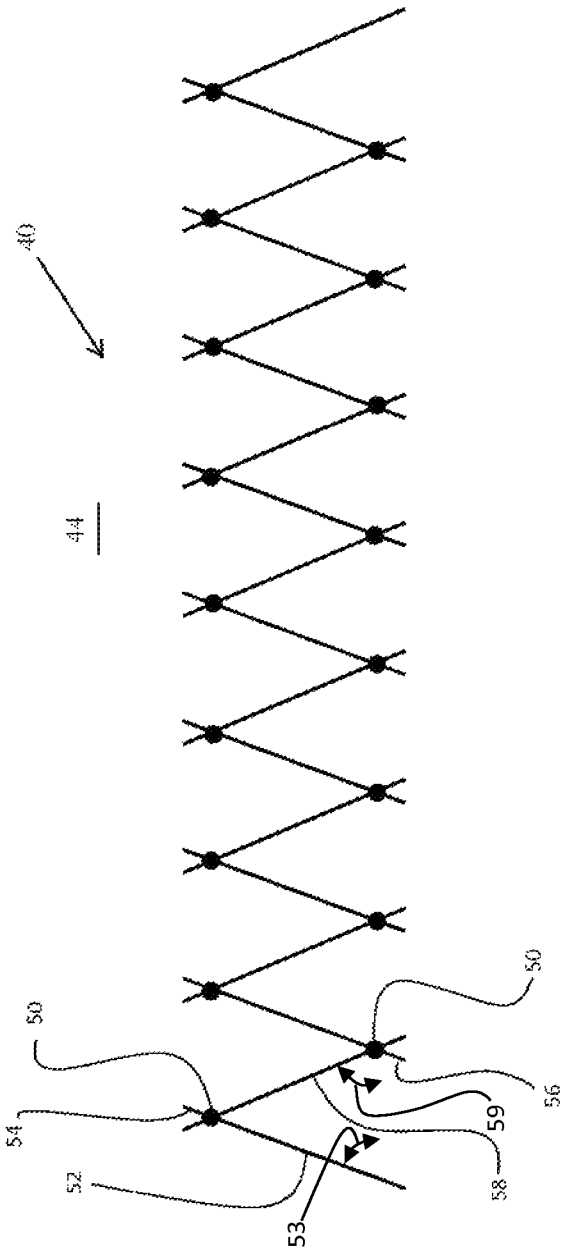


FIG. 4

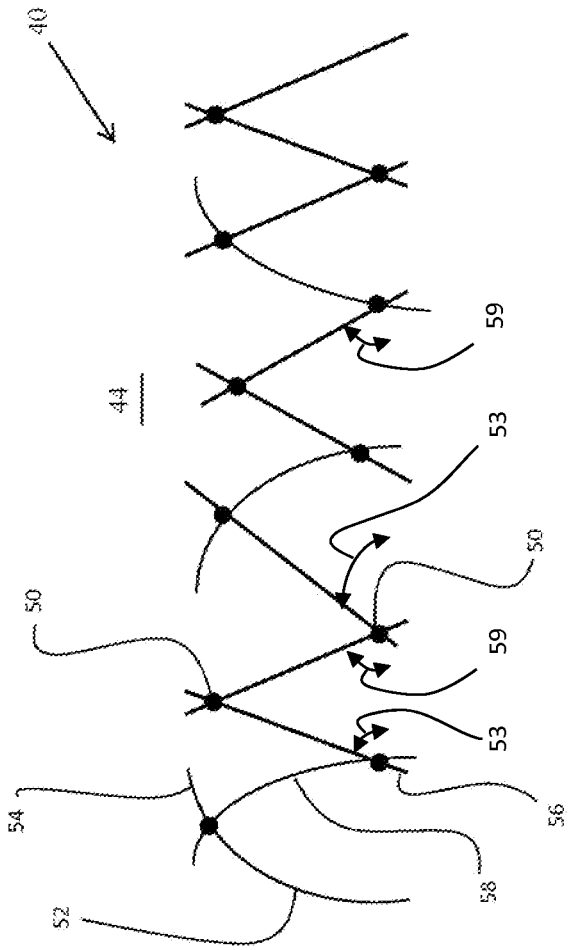


FIG. 5

# PRE-WEAKENED COVER FOR AN AIRBAG AND METHOD OF MAKING

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application No. 61/713,667 filed Oct. 15, 2012, the entire contents of which are incorporated herein by reference thereto.

## BACKGROUND

The present invention relates generally to an instrument panel, driver airbag cover or other interior trim part(s) cover used in a vehicle or any other item having an inflatable cushion or airbag module, and more particularly to an interior trim cover having an integral hidden door and the method of manufacture thereof.

Vehicles are now equipped with some type of inflatable cushions or airbag modules and other vehicle components have been modified to accommodate the use of such systems. For example, most passenger side airbag modules are disposed within and behind an instrument panel which extends across at least a portion of the width of a vehicle compartment. During assembly and/or manufacture, an instrument panel in a vehicle having a passenger side airbag module requires a discrete door which covers an opening formed in the instrument panel for the inflatable cushion to deploy through upon actuation of the airbag module. This separate door is designed to open in response to the force of the expanding inflatable cushion. In other words as the pressure in the inflatable cushion increases, the volume of the cushion increases and applies a force to a portion of the door wherein the door selectively separates from the remaining portion of the instrument panel to permit the inflatable cushion to deploy therethrough.

Accordingly, it is desirable to provide a cover with a pre-weakened area on one side that is not visually perceivable from an opposite side.

## SUMMARY OF THE INVENTION

According to one exemplary embodiment of the present invention, a pre-weakened cover of an airbag module is provided including a layer having an outer show surface and an opposing inner surface. A plurality of first cuts and a plurality of second cuts are arranged on the inner surface. Each of the second cuts intersects two adjacent first cuts to form a generally V-shaped pattern.

In another exemplary embodiment, the layer with the outer show surface is a leather layer or a layer of simulated leather.

According to another embodiment of the invention, a method of making a pre-weakened cover for an airbag module is provided including providing a layer having an outer show surface and an opposing inner surface. A plurality of first cuts is formed in the inner surface at a first angle. A plurality of second cuts is formed in the inner surface at a second angle. The plurality of first cuts and the plurality of second cuts form a generally V-shaped pattern.

In yet another embodiment, the method includes the step of pre-weakening a leather layer or a layer of simulated leather that comprises the outer show surface.

## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described, by way of example only, with reference to the accompanying drawings in which:



FIG. **1** is a partial perspective view of a vehicle interior;

FIG. **2** is a partial cross-sectional view of a vehicle interior;

FIG. **3** is a view of the outer layer along lines **3-3** of FIG. **1**;

FIG. **3**A is a view of a multiple layer instrument panel along the lines **3-3** of FIG. **1**; and

FIG. **4** is a top view of a tear seam according to an embodiment of the present invention; and

FIG. **5** is a top view of an alternate tear seam according to an embodiment of the present invention.

The above-described and other features and advantages of the present application will be appreciated and understood by those skilled in the art from the following detailed description, drawings, and appended claims.

## DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

In accordance with exemplary embodiments of the present invention an airbag module cover/instrument panel with a deployable door and invisible tear seam is provided. In one embodiment, a cutting device is used to provide the tear seam wherein, the tear seam formed by the score is not visually viewable from the outer or show surface of the cover/instrument panel. Non limiting examples of a cutting device include any type of device that can be effectively controlled to provide the desired depths in the scores whether uniform or varying.

In one non-limiting embodiment an ultrasonic embossing or scoring device may be used to score surface **44** wherein at least one blade is oscillated at an ultrasonic frequency as it is advanced into the inner surface of the instrument panel cover to make a very precise cut or score. The depth of this score is controlled very precisely such that the at least one blade will move within a given distance of the outer surface of the instrument panel cover. In addition, the blade configuration itself may be varied to provide the desired effect.

In one application and depending on the material used for the outer layer, the oscillating blade effectively heats and melts the instrument panel cover material at the inner surface to form a given score.

Alternatively a knife or blade may be applied to the surface **44** via an operating device that can effectively control and/or vary the depth of the cut or score in surface **44**. In another embodiment and if applicable, a laser scoring device may be utilized.

By precisely controlling the depth of the score(s), the thickness of the remaining unscored material may be controlled and this is important because it the remaining unscored material thickness which determines the force required for the deployment region to separate along the score(s) to permit the air bag cushion to properly deploy therethrough. When the air bag cushion begins to inflate and build pressure therein, the force of the air bag cushion against the inner surface causes the score(s) defining the periphery of the deployment region to tear or separate to form an opening for the air bag cushion to pass therethrough.

The cover/instrument panel will provide a means for covering a portion of an airbag module, having an inflatable cushion that is positioned to deploy through the deployable door defined by the tear seams/seam of the cover/instrument panel. The pressure of the inflating cushion will cause the deployable door to pivot open while tearing along the tear seams positioned in a portion of cover in order to provide an opening for the inflatable cushion to deploy therethrough while a portion of the deployable door is still pivotally secured to the cover instrument panel.

Referring now to FIGS. **1-2**, an instrument panel is generally indicated at **10**. The instrument panel **10** is assembled

into a vehicle passenger compartment **12**. The instrument panel **10** is generally disposed beneath a windshield **14** and extends across substantially the entire width of the passenger compartment **12**. The instrument panel **10** may additionally include a deployment door **24** formed therein. The deployment door **24** is intended to be in the general area corresponding to a passenger side airbag module **26** (see FIG. **2**). Accordingly, the passenger side airbag module **26** is located and deployed therethrough during actuation under predetermined deployment conditions.

An airbag module **26**, such as the passenger side airbag module for example, includes a housing **28**, an inflator **30** and an inflatable cushion **32**. The inflator **30** inflates the inflatable cushion **32** in response to a signal **34** received from a sensing or control module **36** configured to determine if an activation event is occurring. As is known in the related arts, the control module **36** receives signals **34** from a plurality of sensors disposed throughout the vehicle.

It is, of course, understood that the passenger side airbag module **26** and the configuration of the instrument panel **10** illustrated in FIGS. **1** and **2** are provided as examples and various other configurations of the instrument panel **10** and the airbag module **26** are contemplated. Thus, various embodiments of the present invention are not intended to be limited to the specific configurations illustrated.

The instrument panel **10** may be formed from a plurality of layers, such as an outer layer, an intermediary layer, and a substrate layer for example, each comprising any of a number of suitable materials or combinations thereof. Preferred materials are those materials that have the desired characteristics of strength, durability, flexibility, and finished appearance and feel for use as an instrument panel **10** or a cover for a driver's side airbag module.

As shown in FIG. **3**, an outer layer **18** includes an inner surface **44** that may be positioned adjacent an intermediary layer and an outer show surface **20** that is exposed to the passenger compartment **12**, and therefore, to the occupants of the vehicle. Thus, the outer layer **18** should be formed from a material that has an aesthetically pleasing outer appearance. In one embodiment, the outer layer **18** may be formed from a leather material, such as real leather or simulated leather for example. The outer layer **18** acts as a cover for a portion of an airbag module **26**, such as the airbag module **26** housed within the instrument panel **10** for example. The instrument panel **10** and cover of the airbag module **26** are formed with a tear seam **40** to facilitate the deployment of an airbag module **26**. For example, the tear seam **40** in the cover and instrument panel **10** defines the deployment door **24** through which an airbag module **26** deploys.

FIG. **3**A illustrates a cross-sectional view of a tear seam of an instrument panel **10** in accordance with one non-limiting embodiment. Here and as mentioned above the outer layer **18** has show surface **20** and an inner surface **44** and in this embodiment, the instrument panel/cover has an intermediary foam layer **43** and a substrate layer **45**. The combination of the outer layer **18**, foam layer **43** and substrate layer **45** when separated from the remaining portions of the instrument panel along the tear seam **40** define a deployment door opening in the cover/instrument panel. Of course, the deployment door may simply comprise outer layer **18** and a foam layer **43**. Alternatively, the cover or door may simply comprise only outer layer **18**. Still further the cover and/or door may comprise layer **18** and any other combination of backing layers.

FIG. **3**A shows one non-limiting embodiment wherein the deployment door or opening may be defined by a cut, groove or opening **41** or plurality of cuts, grooves or openings **41** that extends into the cover/instrument panel from the substrate layer **45**, into the foam layer **43** and then are aligned or partially aligned with the tear seam **40** formed in the inner surface **44** of the outer layer **18**. However and as illustrated, the tear seam does not extend all the way through to the outer surface **20** of outer layer **18**. Thus, and when the cover or layer is installed in the vehicle the tear seam is not visible through the show surface. Alternatively, the tear seam **40** may only be formed in outer layer **18**. In yet another embodiment, the tear seam **40** formed in outer layer **18** may be aligned with a tear seam in the foam layer **43** and/or the substrate layer **45**. In yet another embodiment, the tear seam **40** formed in outer layer **18** may be aligned with a tear seam in the foam layer **43** and/or the substrate layer **45**. In still another embodiment, the tear seam **40** formed in outer layer **18** may be completely offset or partially offset from the tear seam in the foam layer **43** and/or the substrate layer **45** or may be partially aligned or partially offset from the tear seam in the foam layer **43** and/or the substrate layer **45** so that only a portion of the tear seam **40** is aligned with the tear seam openings in layers **43** and/or **45**.

Referring now to FIGS. **4** and **5**, the tear seam **40** or a portion of the tear seam **40** includes a plurality of weakened regions **50** on the inner surface **44** of the outer layer **18** such that when the airbag module **26** is actuated, the outer layer **18** tears along this run of weakened regions **50**. In one embodiment, the weakened regions **50** of the tear seam **40** are arranged such that when the airbag module **26** is actuated, the deployment door **24** separates from the remainder of the instrument panel **10** in a series of generally V-shaped or zig-zag pattern. In one embodiment, the tear seam **40** includes a plurality of first cuts **52** and a plurality of second cuts **58** formed at intervals along the periphery of the deployable door **24**. The first and second cuts **52**, **58** may be generally linear or alternatively may be generally curved. The first and second cuts **52**, **58** are non-uniform and consecutive cuts **52**, **58** may vary in both shape and size.

Each of the first cuts **52** are arranged at an angle **53** relative to the deployable door **24**. In one embodiment, the first cuts are arranged at a similar angle, such as a 30 degree or 45 degree angle for example. Alternatively, the first cuts may be arranged at varying angles. The second cuts **58** are also at an angle **59** to the deployable door **24** and are configured to intersect two adjacent first cuts **52** to form a series of generally V-shaped cuts in the inner surface **44**. The plurality of second cuts **58** may be arranged at a similar angle. In one embodiment, the angles formed by the second cuts **58** are equal and opposite to the angles formed by the first cuts **52**. Alternatively, each of the second cuts **58** may be arranged at a varying angle, and the angles of the second cuts **58** may be distinct from the angles of by the first cuts **52**.

The second cuts **58** intersect a first cut **52** near a first end **54** and intersect an adjacent first cut **52** near a second, opposite end **56**. The ends of both the first cut **52** and the second cut **58** extend beyond these intersections to weaken the portion of the outer layer **18** near the intersection. Consequently, the weakened regions **50** of the tear seam **40** are therefore located at these intersections between the first cuts **52** and the second cuts **58**. By forming the first cuts and the second cuts as a mixture of both curved and linear cuts arranged (see at least FIG. **5**) at different angles, the tear seam **40** created in the outer layer **18** will be difficult to detect from the show surface **20** even as the outer layer ages.

In one embodiment, a cutting or scoring device may be used to create the tear seam **40** and weakened regions **50** in the outer layer **18**. Exemplary cutting and scoring devices include but are not limited to a knife, scalpel, rotary knife, and ultrasonic knife for example. Alternatively, a needle punch may be used to generate the intersecting first and second cuts **52**, **58**

of the tear seam **40**. The cutting depth may vary between adjacent cuts **52**, **58** and also may vary between the first end and the second end of each cut. In one embodiment, the cutting depth of the plurality of first cuts **52** and the plurality of second cuts **58** is deeper adjacent an intersection with an adjacent cut.

Though the outer layer **18** is described in the previous embodiment as a cover for a passenger side airbag module **26** in an instrument panel **10**, the outer layer **18** may also be used as a cover for other airbag modules **26** in various locations throughout a vehicle. In particular, the outer layer **18** may be incorporated into any surface (e.g., leather or otherwise) of the vehicle as a cover for an airbag module **26**. For instance, the outer layer **18** may be integrated into a steering wheel, any of the seats in the vehicle, or the paneling on the side of a door. Moreover, the outer layer **18** may be used as a single layer or may be used in combination with other layers such as the intermediary layer and the substrate layer or any combination thereof including other layers or only just the outer layer **18** formed from leather or a simulated leather material.

In accordance with various embodiments of the present invention, the instrument panel may be formed from a plurality of layers each comprising any one of a number of suitable materials or combinations thereof. In one embodiment, the instrument panel may be formed from thermoplastic and thermoset materials and/or a leather material and/or a simulated leather material.

For example, suitable thermoplastic materials include but are not limited to polyethylene based polyolefin elastomer or polypropylene based thermoplastic elastomer, poly-urethane resins and other co-polymers and equivalents thereof. Non-limiting examples include; thermoplastic elastic olefin (TEO), thermoplastic elastomer (TPE), thermoplastic elastomer-oefinic (TPE-O, TPO), thermoplastic elastomer-styrenic (TPE-S), Polycarbonate (PC), Polycarbonate/Acrylonitrile-Butadiene-Styrene (PC/ABS), Acrylonitrile-Butadiene-Styrene (ABS) copolymers, Poly-urethane (TPU) and Polyvinyl-Chloride (PVC).

Non-limiting examples of thermosets include but are not limited to polyamide, polybutadiene, polyether block amide (PEBA), polyetherimide, polyimide, polyurea, polyurethane (PUR), silicone, vinyl ester, phenolic, melamine, urea formaldehyde resins, Fluropolymers such as polytetrafluorethylene (PTFE) and polyvinylidene fluoride (PVDF).

In one non-limiting embodiment the sheet, outer material or outer layer **18** may be formed from materials including but not limited to polyurethane, poly vinyl chloride (PVC), imitation leather, real leather products and any other equivalent material capable of providing the desired show surface. After the sheet of material or outer layer **18** is formed the comprising the tear seam **40** are made in the outer layer **18**. In one embodiment, the show surface **20** of the outer layer **18** may be configured to have a textured or grainy textured to provide an aesthetically pleasing appearance (e.g., a simulated leather texture).

It is, of course, understood that the passenger side airbag module and the configuration of the instrument panel illustrated in the FIGS. are provided as examples and various other configurations of the instrument panel and the airbag module are contemplated thus, the present invention is not intended to be limited to the specific configurations illustrated in the FIGS.

Although a vehicle passenger side airbag is illustrated it is, of course, understood that a deployable airbag door with an invisible tear seam may be formed over any type of vehicle airbag (e.g., driver side, seat, door module, side curtain airbag, knee bolster, etc.) in accordance with various embodiments of the present invention.

Reference is made to the following U.S. Patents the contents each of which are incorporated herein by reference thereto U.S. Pat. Nos. 6,533,314; 6,689,306; 6,692,019; 6,921,105; and 7,093,850. Reference is also made to the following U.S. Patent Publication U.S. 2008/0315566, the contents of which is also incorporated herein by reference thereto.

While the invention has been described with reference to an exemplary embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the present application.

What is claimed is:

**1**. A pre-weakened cover of an airbag module, comprising:
- a leather layer member having an outer show surface and an opposing inner surface;
- a plurality of first cuts arranged on the inner surface; and
- a plurality of second cuts arranged on the inner surface, wherein each of the plurality of second cuts intersects two adjacent first cuts to form a generally V-shaped pattern wherein the plurality of first cuts and the plurality of second cuts are formed by a knife, wherein a plurality of weakened regions are formed at the intersections between the plurality of first cuts and the plurality of second cuts and wherein each of the plurality of first cuts and the plurality of second cuts each have end portions that extend past each intersection to weaken the leather layer member near each intersection.

**2**. The pre-weakened cover according to claim **1**, wherein each of the plurality of first cuts is arranged at a first angle.

**3**. The pre-weakened cover according to claim **2**, wherein the first angle of each of the plurality of first cuts varies.

**4**. The pre-weakened cover according to claim **1**, wherein each of the plurality of second cuts is arranged at a second angle.

**5**. The pre-weakened cover according to claim **4**, wherein the second angle of each of the plurality of second cuts varies.

**6**. The pre-weakened cover according to claim **1**, wherein the plurality of first cuts and the plurality of second cuts are non-uniform in shape and size.

**7**. The pre-weakened cover according to claim **1**, wherein the cover is configured to tear along the generally V-shaped pattern between the plurality of weakened regions.

**8**. The pre-weakened cover according to claim **1**, wherein the plurality of first cuts and the plurality of second cuts are only formed in the leather layer member.

**9**. A method of making a pre-weakened cover of an airbag module comprising:
- providing a leather layer member having an outer show surface and an opposing inner surface;
- forming a plurality of first cuts in the inner surface at a first angle with a knife; and
- forming a plurality of second cuts in the inner surface at a second angle with the knife such that the plurality of first cuts and the plurality of second cuts form a generally V-shaped pattern, wherein a weakened region is formed at each intersection between a second cut and a first cut and wherein each of the plurality of first cuts and the

plurality of second cuts each have end portions that extend past each intersection to weaken the leather layer member near each intersection.

**10**. The method according to claim **9**, wherein the first angle of each of the plurality of first cuts varies.

**11**. The method according to claim **9**, wherein the second angle of each of the plurality of second cuts varies.

**12**. The method according to claim **9**, wherein the plurality of first cuts and the plurality of second cuts are non-uniform in shape and size.

**13**. The method according to claim **9**, wherein the plurality of second cuts intersect two adjacent first cuts.

**14**. The method according to claim **9**, wherein the cover is configured to tear along the generally V-shaped pattern between the plurality of weakened regions.

**15**. The method according to claim **9**, wherein the plurality of first cuts and the plurality of second cuts are only formed in the leather layer member.

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